UNIVERSITY OF GOTHENBURG

SCHOOL OF BUSINESS, ECONOMICS AND LAW

Natural Disasters – A Macroeconomic Perspective

A comparative study of economic and human effects caused by natural disasters in developing and developed countries

Bachelor Thesis, 15 HP

Department of Economics and Statistics

Spring 2013

Authors:

Louise Stöök 9002190363

Jesper Gille 8910114613

Supervisor:

Per-Åke Andersson, School of Business, Economics and Law

Abstract

Natural disasters happen in all parts of the world, some countries are situated in especially hazardous area being extra vulnerable. Since it is not possible to move an entire country out of the way of a coming natural disaster, consequences, often severe, are unavoidable.

This study seek to find an explanation to why rich countries are losing more money and poor countries are losing more people due to natural disasters. To illustrate the economic and human impact of natural disasters in a country, there will be discussions about four major disasters having occurred during the past decade. For the analysis, multiple regressions are used for developed and developing countries divided into two groups where independent variables will be such considered important to evaluate a country's degree of development.

The regression results imply that the variables used for defining level of development in a country does not explain the extent of economic losses due to natural disaster, nor does it explain the number of lives lost. However, reality proves that differences in economic losses and loss of lives actually are depending on how developed a country is which is supported by the four disasters presented in the study.

Keywords: Natural disaster, economic effects, human effects, differences, developing countries, developed countries

Table of Contents

1. Introduction

1.1 Background

Natural disasters are a phenomenon that has come to be very common over the past century. It has been discussed whether natural disasters are caused by the climate changes or not. According to National Aeronautics and Space Administration (NASA) Earth Observatory, they are not. Although, they discuss models showing evidence for climate changes to cause natural disasters to become more frequent and more severe in the future since a higher global temperature will affect the weather in such a way (Riebeek, 2005).

According to the Swedish National Encyclopedia, 2013, a natural disaster is defined as an event caused by nature with severe implications on society and environment. In general, natural events causing catastrophes derives from geological, meteorological or hydrological abnormalities. The prevalence of an extensive natural event does not necessarily cause a disaster, but when it does, it usually takes on the form of earthquakes, volcanic eruptions, tsunamis, floods, droughts or hurricanes.

Since 1970, the world have suffered from more than 9 800 natural disasters with a total death toll close to 4 million people and overall affecting almost 6 billion people. The total economic losses accounts for several trillion dollars (Kellenberg and Mobarak, 2011).

A natural disaster of a high degree will damage a country in a broad macroeconomic sense. Infrastructure will suffer, in different extents depending on how well prepared a country is for a potential natural disaster and depending on how much money is invested in the infrastructure. People will suffer, in many cases people will even die. It is a fact that a severe natural disaster will infer with the economy of a country, but it is difficult to say by how much (Riebeek, 2005).

It takes efforts from a country's government to invest in prevention and preparedness which will reduce the costs of recovery and reconstruction. The poorest countries are naturally more vulnerable to natural disasters since they are not able to invest in prevention and preparedness the same extent as wealthier countries (United Nations News Centre, 2013a). Poor countries are also more vulnerable because of limited access to the technology of today. It has been shown that especially information technology has been used for prevention, response and recovery (United Nations News Centre, 2013b).

1.2 Purpose and Research Questions

The purpose with this study is to find out what variables may be the reason to why developing countries lose more lives due to a natural disaster compared to developed countries and why developed countries lose more money than developing countries.

Our research questions are the following:

- How is a country's level of development correlated with the level of economic loss they suffer from a natural disaster?
- How is a country's level of development correlated with the number of deaths caused by a natural disaster?

2 Method

An inductive approach is chosen as groundwork for the comparative analysis where a discussion about economic and human effects caused by a natural disaster will be presented in the empirical section. This will be continued by detailed observations of four natural disasters that have occurred this past decade. These four disasters have caused some of the worst damages in history in an economic and human perspective. Two of them were concentrated in poor, undeveloped areas of the world whereas the other two took place in two of the world's most well-developed countries. The analysis will be based on regressions of economic losses and loss of lives for one group of developed countries and one group of developing countries.

The observations will be examined more specifically by looking into the economic effects of a natural disaster and dividing total GDP into the simple production function Y=F (A, K, L). To assess how the effects from a natural disaster are differentiated, the empirical section will include descriptions of how these variables get affected by the disaster combined by discussions about how they affect the country in an economic sense.

In the production function, *Y* is real GDP or total output, *K* is physical capital being here equal to the capital stock of a country which is represented by investments in land, plants, machinery, equipment, construction of roads, railways, schools, offices, hospitals, private residential dwellings and commercial and industrial buildings (World Bank, 2013). *L* is the inputs of human capital which we decided to value as the size of the labor force of the country. *A* represent changes in technology and efficiency or "Total Factor Productivity". This is usually difficult to estimate which is why it is in general referred to as the residual - the part of GDP growth we cannot explain (About Economics, 2013). In this study Total Factor Productivity will be defined as how well labor and physical capital is combined in producing output.

In the analysis, four multiple regressions will be carried out, using the data analysis and statistical software Stata. First to assess whether there is a correlation between the variables defining level of development and the level of economic damages countries suffer due to a natural disaster. This will be continued by examining a potential correlation between the number of deaths and the variables defining level of development. In the regressions, observations from several natural disasters will be used, both developing and developed countries, including the four countries that will be discussed in the empirical section. The natural events chosen for the study are considered a disaster according to the guidelines of the International Disaster Database which are:

• Ten (10) or more people reported killed.
• Hundred (100) or more people reported affected.
• Declaration of a state of emergency.
• Call for international assistance.

Developed and developing countries will be divided into two groups and the regressions will be performed separately for these groups in order to detect potential differences between them. The independent variables will be such variables that are found appropriate for measuring what state of development the country is in for the year of the disaster. These variables will be explained in chapter 4 – Analysis.

3 Empirical Data

3.1 Economic and Human Effects of a Natural Disaster

Economic losses are a lot higher and have increased steadily in developed countries since 1970, while in developing countries the economic value of losses has remained quite stable. This is likely to be the case because developed countries have invested a lot more money in their societies (Kellenberg and Mobarak, 2011). A contributor to a higher total cost caused by a natural disaster is if the reconstruction phase is carried out for a longer period of time (Hallegatte and Przyluski, 2010).

Usually when investigating the effects of a natural disaster there is a division between direct and indirect losses. Direct losses refer to consequences surfacing directly after the occurrence, e.g. everything that gets physically destroyed when a tsunami makes its way. Indirect losses, on the other hand, are those caused by the direct losses, e.g. if a big power plant gets demolished by a storm there would be severe interruptions and disturbances for many businesses and for people in their everyday life. Indirect losses are often measured by the changes observed in total GDP after a natural disaster, however, it has been discussed whether if it is really credible or not. This is because some people do not consider GDP to be a good proxy variable for measuring welfare as well as that there has been arguments about what scale is proper to use between the scale of the event and the scale used when measuring GDP (Hallegatte and Przyluski, 2010).

A rich, well-developed country will not display a large impact on GDP from disaster damages even if the economic losses are very big. For a developing country with a low GDP, on the other hand, the economic effects on total GDP will be much more obvious. After the event of a natural disaster it is likely that there will be a large inflow of foreign aid that might lower the macroeconomic consequences (Raddatz, 2009).

In the short run after the occurrence of a natural disaster, there is usually a steep decline in GDP for the time closest after the event. In the short run, production factors are said to be fixed so if one or more input would go missing it would definitely damage and slow down the

production (Hallegatte and Przyluski, 2010). In the long run, effects from natural disasters on macroeconomic variables can be either positive or negative depending on what type of institutions a country holds and it is believed by some people that natural disaster actually can contribute to long-term growth (Popp, 2006).

The number of deaths in rich countries, such countries who are members of The Organisation for Economic Co-operation and Development (OECD), have for a long time been on a rather stable level while the number of deaths in poor countries have for a long time been a lot higher, though lately it has been noticed to decrease. They are not on the same level as OECD-countries but it has become better (Kellenberg and Mobarak, 2011).

When a natural disaster occurs infrastructure play a great role in protecting people. Well-functioning roads and bridges are important for evacuation and public buildings must be well-structured to serve as shelter (Oh, Deshmukh and Hastak, 2010).

A quick response is crucial in order to save lives, protect properties and make damaged areas safe again. During the recovery phase, the country or parish act to regain functional living standards including initial recovery where the more basic needs are covered and long-term recovery where focus lies on reconstruction and rehabilitation (Queensland Government, 2013). What can be seen as positive in a situation like this is that reconstructing parts of a society will give a chance to develop and improve economic sectors as well as improving technology, infrastructure and productivity (Hallegatte and Przyluski, 2010).

3.2 Hurricane Katrina (2005)

Hurricane Katrina hit the gulf coast of the United States (U.S) august 29, 2005 with a Category 3 rating on the Saffir-Simpson Hurricane Scale meaning that the winds came in with strength of 100-140 miles per hour (The History Channel website, 2013). Louisiana, Mississippi and Alabama got worst affected by Katrina where Louisiana suffered the most severe consequences due to the massive flooding of New Orleans in the aftermath (Do Something.com). Economic damages reached a total of $125 billion which makes it the largest disaster in the U.S. since 1900 in an economic sense. It caused 1 833 people to die because of it (The International Disaster Database, 2013).

In the U.S. there are several regions that often suffer from extreme weather conditions causing natural disasters. Hurricanes are most common on the east coast and can severely damage the coastal cities. Natural disasters may be highly destructive, but the U.S. is a well developed country and after experiencing a natural disaster, the U.S. have good possibilities to, with advanced technology, labor and heavy resources, rebuild areas of destruction relatively fast (Department of Homeland Security, 2013).

Louisiana is among the poorest five states in the country when looking at per capita income. Although this does not make them poor in a relative sense compared to poor countries around the world, since they had a real GDP of $196 billion the year of the disaster (U.S. Bureau of

Economic Analysis, 2012). Louisiana is the third largest producer of petroleum and the second largest of natural gas in the U.S. therefore it accounts for a lot of the state incomes (Division of Administration, 2008).

3.2.1 Human Capital

Before the entry of hurricane Katrina in Louisiana, many had time to evacuate which led to a decrease in the population size with about 250 000 people between 2005 and 2006 since it was difficult to return for a long time after the disaster (The History Channel website, 2013). There was just one major lack in the evacuation plan before the storm – a neglect of those that did not have access to a vehicle. People that were not able to evacuate had to move to the New Orleans football stadium. During six days, approximately 20 000 people were stuck in the superdome, with small amount of water and food and no medical staff before they were able to leave (Murphy, 2010).

The labor force is, obviously, highly dependent on the population. In 2005, prior to the hurricane, Louisiana had a labor force of 2 066 599 people. In January, five months after the disaster, the number had become largely reduced. The large number of the population that became homeless and had to move away caused the labor force to diminish to 1 968 064 (Econterms, 2013). This decrease did not last for very long since many made efforts to rebuild their old homes and properties in order to go back to their normal lives, just two years after the event the majority of the evacuees had returned (Guidotti, 2006). The size of the Louisiana population was back to its pre-Katrina level in 2011, which gives an illustration of how severe the damages actually were (The History Channel website, 2013).

Talking about quality of labor can be linked to the general health conditions of the population. This did not become an issue in the aftermath of Katrina. The risks of water contamination was instantly examined and documented, people became warned about the risks from carbon monoxide from portable generators and identification of dermatitis was carried out as well as wound infections as major health risks and warnings of outbreaks of norovirus-induced gastroenteritis (Guidotti, 2006).

3.2.2 Physical Capital

The infrastructure in the affected areas was said, by Professor Robert Miller at the National Defense University, to have experienced a total collapse as a repercussion of hurricane Katrina. He compares the infrastructural damages to be in the same extent as those of Germany from World War II (McNeill, Carafano, Mayer and Weitz, 2011).

Looking at the value of the capital stock for Louisiana, we see that between the years 1999-2004 it has increased from $23.8 billion to $31.1 billion quite steadily. Looking at the value of the capital stock for the five year period 2005-2010 it rose from $32.6 billion to $48.5 billion representing a larger change than the five-year period prior to hurricane Katrina (Chantrill, 2013). The capital stock is valued by the sum of investments and a major recovery mission,

like this one, creates a very big need for investments in physical capital. When new investments starts to flow in the value will increase and create growth in the economy (World Bank, 2013).

What created the most critical consequences in the aftermath was the breaking of the levees in New Orleans, causing severe flooding of about 75% of the metropolitan area (Sills, Vroman, Wahl and Schwans, 2008). Before all the water had been pumped out of the city more than two months had passed. Because of that, emergency services had to move around the city by boat in order to help those in need (Flood Site Project, 2009). The flooding also resulted in the port of New Orleans, which is a major cargo transportation center in the southeast, to become indisposed for seven months after the disaster (Amadeo, 2012).

The biggest economic loss was attached to the oil industry – hurricane Katrina affected 19% of total U.S. oil production (Amadeo, 2012). Several oil and gas refineries were shut down for more than a week (Park, Moore, Gordon and Richardson, 2010). Oil prices increased by $3 a barrel nationwide, and gas prices nearly amounted to $5 a gallon. In order to prevent the escalating gas prices, the U.S. government released oil from its stockpile in the Strategic Petroleum Reserves (Amadeo, 2012).

3.2.3 Technology and Efficiency

When it comes to Total Factor Productivity, the United States is a well-developed country. Productivity is likely to have suffered from hurricane Katrina since there were so many physical damages causing many businesses and factories to shut down and energy prices to rise. Therefore it is highly probable that productivity slowed down in the affected areas for a while until reconstruction started (Brainmass, 2013). However, there are not any exact numbers on this. Getting back to effectiveness and productiveness will depend on how fast the reconstruction is carried out and even if it is possible to build back better, the economy will not be as productive as it was before the disaster for a long time (Stone, 2012).

3.2.4 Recovery and Reconstruction

In order to boost the economic development in Louisiana, several programs were established to provide capital and technical assistance etc. to businesses that became damaged. They sought out to achieve success in this by following the guidelines learned from the situation after the 9/11 incidence. The plan was to seek assistance from non-profit organizations and Community Development Financial Institutions and then encourage the respondents into partnerships to serve a specific geographical area or a specific industry (Louisiana Recovery Authority, 2006).

In 2007, around $6.7 billion was invested in reconstructing Louisiana homes, schools and other infrastructure. In order to rebuild homes in Louisiana the Road Home Program was created and has successfully helped more than 129 000 Louisiana citizens. The residents of Louisiana received more than $8.9 billion to rebuild their homes (The Road Home).

After the hurricane, the federal government authorized $12.8 million in funding to rebuild the levees protecting New Orleans. In 2010, $15 billion was spent on the reconstruction work and it was completed in 2011. The levees are built in order to be able to protect the city of a 100-year storm which refers to a hurricane with one percent chance of making landfall in any given year. If a 400 year storm in the size of Katrina would hit the city, they would get affected but not in the same extent as in 2005. New interim control structures and pump stations will be able to protect the city for over flooding of the canals (Army Corps of Engineering, 2010).

Total GDP growth in the U.S. went from being 3.8% in the third quarter of 2005 to 1.3% in the fourth quarter, but by the first quarter of 2006 GDP growth had reached a level of 4.8% much thanks to a general strength in the U.S. economy at the time (Amadeo, 2012). Something that has been argued after hurricane Katrina is that even though the states that got hit are geographically very large they don't play a large role in the U.S. economy. In total, they accounted for about 2% of total U.S. GDP in 2004 (Cashell and Labonte, 2005). The effects that could be seen on the entire U.S. economy were because of the temporary interruption in suppliance of oil, natural gas and gasoline (Herman, 2006). In the state of Louisiana, real GDP went from $196 billion in 2005 to diminish to $192 in 2006 and then it continued to decrease until the year of 2010 (U.S. Bureau of Economic Analysis, 2012).

3.3 Japan Earthquake (2011)

The earthquake that hit Japan in 2011, with its epicenter east of Sendai on Honshu, had a magnitude of 9.0 on the Richter scale which ranks it the fourth largest in the world since 1900 and the largest in the history of Japan. This earthquake brought with it a violent tsunami that destroyed the nuclear power station at Fukushima (Lundahl, 2012). It killed almost 16 000 people, nearly swept away entire cities and wrecked over 300 000 buildings on the east coast. The economic loss for Japan is estimated to $177.7 billion (Japan Reconstruction Agency, 2013) and the reconstruction was expected to cost about 300 billion USD (Johannesson, 2011). However, when looking at the bigger picture, the parts of Japan that was worst hit by the disaster accounts only for 2.5 % of the total economy (Government of Japan, 2011).

Japan started its mission towards sustained growth in the late 19th century with the fall of their last "shogun" and instead moving towards more modern politics influenced by Western-Europe. In just about 50 years, Japan went from being a farming community to a very up-to-date, industrialized nation (Johannesson, 2011). Japan is now considered to be one of the world's leading, industrialized countries and they have moved towards this achievement with tremendous speed and determination. In 2011 they were accounted to hold for 8.7 % of global GDP and ranked the third-largest economy in the world (Nanto, Cooper, Donnelly and Johnson, 2011).

3.3.1 Human Capital

Since Japan is a country that is often disturbed by major natural events they put much effort into be ready for them. Regular evacuation drills are held at least once a year on municipal levels in order to maintain and improve awareness as well as preparedness among the population. There's also a high-tech warning system which will give everyone some tens of seconds of warning, giving people time to take cover (Fraser, Matsuo, Leonard and Murakami, 2012).

People who lived in the danger areas were told by Japanese television to escape to high, strong buildings and stay there until the tsunami had passed. Fortunately, Japan has many well-developed building codes and public education programs with a single purpose: to save lives and minimizes damages from natural disasters. There are several tsunami shelters that are built specifically to resist the strength of nature, many schools and other public buildings are renovated in order to hold evacuees when necessary (McRae, 2011).

For the people who lived close to the power station Fukushima, evacuation became necessary after the tsunami had triggered the massive nuclear accident and it started to let out abnormal levels of radioactive materials in the air. The Japanese prime minister ordered everyone who lived within 20 kilometers from a station to evacuate out of the danger zone (Nishino, Ouchi, Tsuburaya, Tanaka and Hokugo, 2012).

The National Police Agency of Japan reported a total death toll of 15 698 people after the earthquake. Compared to the size of their population, almost 128 million in 2011, it is not a very large share, very likely thanks to the well carried out evacuation. Both population size and size of the Japanese labor force have remained on a stable level since 1999, the labor force today includes more than 66 million people (World Bank, 2013).

3.3.2 Physical Capital

Direct effects of a natural disaster are in general mostly concentrated to the area closest to the epicenter and that is what happened since the area around Sendai in Japan got severely affected. Because of the damages on the nuclear power station in Fukushima, the effects in this case will affect the whole country in a large scale bringing with it limitations in the use of electricity and a shortage of gasoline which impedes on the recovery process (Nanto et al., 2011). The tsunami caused radiation to start leaking and because of failures in the plant's cooling system, fires and explosions took out four of the six reactor buildings. The accident in Fukushima revealed serious weaknesses in the nuclear industry's regulatory systems and their safety standards (Buerk, 2012).

Many companies got their factories damaged or destroyed because of the earthquake and the tsunami, which forced them to interrupt distributions and transports (Johannesson, 2011). Overall, production was very badly affected and business confidence grew low (Maps of World, 2012).

In 2011, the Japanese capital stock had a total value of $1 165 603 307 856 which is among the highest levels of investments in physical capital in the world (World Bank, 2013). Japan's economic growth in 2011 is estimated to have declined by 1 %, measured in real GDP. A year after in 2012, Japan's decline in economic growth is turning. Industrial productions have had a growth of 5.8 %. The turnaround of the economy is much due to reconstruction of infrastructure in the affected areas (Witherell, 2012).

3.3.3 Technology & Efficiency

Japan has, for a long time, been well-known for having a very productive labor force which is one important reason to why they have become so successful. Japanese companies are also known for being inventive and to have a good know-how (Japan Inc, 2008). Being one of the leading countries in the world when it comes to productivity and efficiency means that efforts needs to be put into constantly improving and developing. Japan has continued to have a strong productivity the past decade, contributing to a high GDP growth. In order for them to maintain this growth, it is believed that they must better handle the variation in productivity performance across sectors and the shrinking labor force (Corbett, 2012).

3.3.4 Recovery and Reconstruction

On July 29 the same year as the earthquake, a structured plan for the reconstruction phase was established by the Reconstruction Headquarters in cooperation with the local governments in the most affected areas and the Reconstruction Design Council. The plan was to have an "open reconstruction" in order to show the rest of the world that Japan can still be an attractive economy and business centre. The reconstruction was estimated to a ten-year period with the first five years being the most intensive. The plan is set up as follows:

- Building disaster resistant and resilient regions
- Restoration of life in communities
- Revival of local economic activities
- Nation building which incorporate lessons learnt from the Great Earthquake
- Incorporating initiatives towards reconstruction from the nuclear accident

In the critical disaster areas there were some additional initiatives:

- Setting up a "System of special zone for reconstruction" and "Easy-to-use-grants
- Providing support to ensure that the private sector will be activated to its maximum extent

(Ministry of Foreign Affairs of Japan, 2011)

The new prime minister is putting great efforts into stabilizing the Japanese economy and his main focus lies on infrastructure and working with the Central Bank in order to counteract the deflation (Ministry of Foreign Affairs of Japan, 2011). The fact that Japan has moved into an expansionary monetary policy, is believed to be of great assistance in their mission to re-activating the economy (Witherell, 2012).

The Japanese emphasizes that they are eager to keep Japan open to the world, they want to attract more investors and promote doing business in Japan to be able to get back on their feet. Especially, they aimed to attract FDI to the damaged areas. Reconstructing what was damaged after the earthquake and the tsunami remains a priority for Japan until today, a little more than two years after. They strive to be one of the world's leading countries when it comes to global challenges. Japan is very positive about their recovery process and they are certain to achieve their goals in this matter in the near future (Ministry of Foreign Affairs of Japan, 2011). Japan was estimated to have a growth rate of 2.2 % in 2012 compared to the negative growth rate straight after the catastrophe (Index Mundi, 2013).

3.4 Haiti Earthquake (2010)

Haiti has a history plagued by one corrupt leader after another, combined with a location that causes natural disasters to occur on a frequent basis, every 5-7 year they are hit by a major disaster. The weak political state throughout the history of Haiti is the main explanation to why it is such an underdeveloped country. More than three-quarters of the population live off less than $2/day and more than half live in extreme poverty (less than $1/day) (Lundahl, 2012).

Despite the fact that Haiti is a country very used to getting in the middle of a chaos caused by nature, being hit by an earthquake that measures 7.0 on the Richter scale is a worst case scenario. The earthquake in January, 2010, was said by The International Crisis Group in 2011 to be "The deadliest disaster that ever occurred in the Western Hemisphere" and it wiped out the few economic gains that had been achieved the past decade (Lundahl, 2012).
The magnitude of the Haitian earthquake was smaller than, for example, the one in Japan in 2011, but yet it affected about three to six times more victims in Haiti. The number of deaths could have been restricted to some dozen people if Haiti had been prepared in the same way that Japan was (Lundahl, 2012).

Estimates about how many got killed have resulted in different numbers, some range over 300000 people while others came up with numbers around 65 000 – 115 000, an exact number has not been able to retrieve (Lundahl, 2012). In any case, it is quite a lot compared to a total population size of 9.9 million people (World Bank Data, 2013). All in all, about 3 million people were in some way affected by the earthquake. The amount of damage and losses reaches a level of $7.9 billion US dollar and the entire recovery and reconstruction phase is estimated to cost about $11.5 billion US dollar. A state of emergency for the whole country was declared for 18 months. The horrible outcome of this disaster is mainly caused by the

ignorant behavior of the Haitian government when it comes to their population and maintenance of the country in general (Lundahl, 2012).

3.4.1 Human Capital

As said earlier, many died as a direct cause of the earthquake. Evacuation before was not possible since Haiti didn't have an early warning system against natural disasters. Not until after the earthquake people got evacuated, put in over-crowded camp sites (Lundahl, 2012).

The labor force of Haiti includes about one third of the total population and has been about the same since the beginning of the 21th century. Interesting when looking at these numbers, is that the population has steadily increased since 1999 until today from 8 million to over 10 million people in 2011. Whereas the labor force have become smaller since 1999, losing almost one million workers in ten years. Therefore it is not possible to say whether the decrease in the labor force size between 2010 and 2011 is caused by the earthquake or not (World Bank, 2013).

When it comes to the quality of human capital, Haiti is not especially well off compared to the rest of the world. It is well-known that the Government of Haiti is not prioritizing health care of the people or educating them. The most recent numbers are from 2006 when a report was released by the World Bank. By then, half of the population had no access to health care and only 60% could read (Lundahl, 2012). Since the majority of hospitals, health centers and educational institutions collapsed the situation directly after the quake was worse than ever (Inside Disaster, 2010).

In October the same year as the earthquake, Haiti was hit by a serious outbreak of cholera distracting the aid communities from rebuilding and development issues caused by the earthquake, forcing them to provide emergency assistance instead. Haiti has now come to be the most cholera-common country in the world and the disease has not stopped spreading. The rapid spread has been and is still, mainly due to the very common use of river-water for washing, bathing, drinking etc. and in 2012, reports showed that over 500 000 people were infected (Lundahl, 2012). The Ministry of Health in Haiti has established a 10-year national cholera eradication plan with a main focus on improving water supply and sanitation facilities. Unfortunately, the number of affected people is expected to increase in 2013 (Amunátegui, 2012).

3.4.2 Physical Capital

The Government of Haiti has not been putting much effort into building and improving physical capital of the nation over the years. The year before the earthquake the capital stock had a value of $1 775 855 516 and in 2011 it had increased with investments valued to more than $4 million (World Bank, 2013).

In total, over 300 000 homes got destroyed or damaged, along with the main port and most of the governmental, ministerial and public administration buildings (Inside Disaster). The capital, Port-au-Prince, got 40 % of its buildings destroyed or damaged and about 80 % of the city Léogâne, in the epicenter of the quake, was destroyed. All in all, 10 million cubic meters of rubble was produced by the earthquake (Lundahl, 2012). The total amount of damage and losses is said to be $7.9 billion which is more than their total GDP at the time (Inside Disaster, 2010).

3.4.3 Technology and Efficiency

Total Factor Productivity in Haiti isn't very encouraging since it is something that is highly depending on the quality of both physical and human capital. During the past four decades, Total Factor Productivity has been negative in Haiti because of their economic difficulties. When the workers are not educated, they lack the ability to contribute in developing technologies which will prevent development. Efficiency can be focused on first after human and physical capital has become trustworthy and sustainable. An important explanation to these shortcomings is again the incomplete involvement in the society of the Haitian Government (Diaz, Trapp and Feldman, 2008).

3.4.4 Recovery and Reconstruction

What became the top priority directly after the earthquake was the evacuation process of 1.3 million people affected by the disaster. Campsites were set up for these people to serve as temporary resorts awaiting the restoration of their old homes. What came unaccounted for was that many people who were put in the camps chose to stay because they were offered better living conditions than before the disaster, despite the fact that the camps created a lot of crime and violence. The current president have recently tried to force a lot of people out of the camps not caring if they had anywhere to go but there were many who refused to leave (Lundahl, 2012). The interregional advisor of UN Habitat, Jean-Yves Barcelo, made a statement in November 2011 saying that *"to displace communities to new cities and new neighborhoods... would require resources which the least developed countries like Haiti do not have, even with the exceptional levels of international aid mobilized after a large-scale disaster"*. As of April 2013, there are still 320 000 people living in 385 camps where all of them are constantly threatened by forced evictions (Amnesty International, 2013).

The immense need for reconstructing buildings and general infrastructure is obvious and it offers a great challenge. What creates issues with this matter is the enormous amount of debris lying all around the cities. In 2010, about two million cubic meters of rubble out of ten was removed. One reason to why it has been so difficult to remove the debris is the weak state of cooperation between international actors as well as the issues with landownership causing large issues about where to leave and treat the rubble. Another reason is the fact that many roads are in such bad states that it causes problems for those working to clear up all the rubble. By January 2013, a report was released by the United Nations Development

Programme revealing that 80% of all the rubble had been taken care of at this point (Lundahl, 2012).

Overall, recovery has been rather slow which without doubt is caused by the weak political institutions. What happened after the earthquake was literally that the government of Haiti declared a state of emergency and then relied on the international community to contribute with funding and expertise (Lundahl, 2012). Despite this, Haiti had a GDP growth rate of 5.6 % in 2011 compared to the -5.4 % in 2010 after the earthquake and the latest data from 2012 estimates a growth rate of 7.8 % (Global Finance, 2013).

3.5 Indian Ocean Tsunami (2004)

December 26, 2004 an earthquake measuring 9.0 on the Richter scale created a massive tsunami in the Indian Ocean southeast of Banda Aceh, Indonesia. The tsunami hit several countries, e.g. Thailand, Sri Lanka and Indian but the worst affected region was the province of Aceh in the northern part of Sumatra, Indonesia. Without any warning, four enormous waves crashed the shores, the highest was estimated to 24 meters. Water masses flooded the shoreline and claimed approximately 168 000 people (Szczepanski, 2013). More than 800 kilometers of coastline was affected and close to 53 795 land parcels were destroyed (Bell, 2011).

3.5.1 Human Capital

The labor force has steadily increased over the last decade, from 94 847 200 in 1999 to 118 385 000 in 2011. Even during the large reconstruction period from 2004 to 2008 there was no significant difference in Indonesia's total labor force (World Bank, 2013). Aceh's overall health care was ranked 18 out of 33 provinces in 2008 by the UN. The ranking is based on average life expectancy, infant mortality rate, morbidity rate, population self-medicating and population without access to facilities. Life expectancy varies from different areas in Aceh, from 69 to 71 years. Adult literacy rate in 2003 was 98 % but in 2006 it had decreased to 96.6 % which is probably due to the consequences of the tsunami when school and public facilities were destroyed (UN Provincial Human Development Report Aceh, 2010).

3.5.2 Physical Capital

The tsunami had severe effects on physical capital. According to J. Hendersson and Y. Lee research, the mean survival rate of houses in Aceh villages for the overall sample was 9 % and for public buildings only 6 % (J. Hendersson and Y. Lee, 2011). Capital stock in 2004 was valued $61 785 619 642 and $71 699 876 422 in 2005 where we see an increase of about $10 000 000 000 (World Bank, 2013). This increase in investments comes from the major rebuilding effort which also describes how badly Aceh was damaged. One of the most important pieces of infrastructure was destroyed by the tsunami – Aceh's economical core, the 242 km road linking Banda Aceh and Meulaboh with more than 110 bridges and crossings

all of which got damaged or destroyed (Parsons, 2012). Around $9.9 billion was estimated to be the value of economic, infrastructure, and human development losses (Tsunami Evaluation Coalition, 2007).

3.5.3 Technology and Efficiency

The heavy reconstruction has fueled the economy and the labor force in Aceh. Before the tsunami, low-skilled work within agriculture was the most employing sector. Aceh is one of the richest areas in Indonesia in terms of natural resources (James, 2006). When natural gas was found in Aceh 1971, the Indonesian government founded the Lhokseumawe Industrial Zone (LIZ) with investments from Exxon Mobile. The gas industry had few linkages, was capital intensive and demanded high skilled labor, none of these were found in Aceh. The presence of the Tentara National Indonesia (TNI – Indonesian Defense Force), whose directive was to protect the gas industry (LIZ), worsened the economic situation in Aceh. TNI was involved in business all around Indonesia, mostly legitimate. However, the business TNI had in Aceh focused on drugs, arms, robberies, protection, extortion and illegal exploitation of plantations and forests (ICG, 2001a).

3.5.4 Recovery and Reconstruction

After the catastrophe, a quick response in aiding the people of Aceh came from many directions – the Indonesian government, NGO's and the international community. Together they pledged assistance for reconstruction and development worth $7.7 billion. The Indonesian government was quick in coordinating the National Coordinating Board for Disaster Management and IDPs to direct all their resources to Aceh. They focused at immediate support in forms of search and rescue, food, shelter and medical support. The international community acted quickly and was in place two days after the catastrophe. Lack of coordination between government and different relief actors resulted in excess of some interventions for example medical teams and shortage in water supply (BNPB, 2007).

After the emergency phase had ended on March 25, 2005, the Indonesian government took aim on long-term reconstruction by ordering numerous institutions to cooperate with international bodies to create the Master Plan. Included in the Master Plan was the new law – the Indonesia Disaster Management Law. It was implemented by the government to protect the entire nation by providing protection for lives and livelihood including protection against disasters in order to attain public welfare (BNPB, 2007).

Most of the relief supporters devoted their time to reconstruction of houses. The minimum level of core needs in reconstruction of infrastructure was $2.6 billion and the actual amount spent was $3.1 billion. The surplus gave a chance to build back and build back better. Reconstruction projects were all difficult, much due to socioeconomic issues, such as property rights, equity, increasing unit costs and trough varied in the quality of completed houses.
114 000 units of houses had been built by July 2008 out of the estimated 130 000 needed. The massive amount of funding that came with the reconstruction and rehabilitation programs

triggered economic growth, gross regional domestic product rose in 2006 with 6.6 % and 3.7 % in 2007. The results are above national average level. Growth started to decline when the reconstruction programs draw to its end (World Bank, 2009a).

4 Analysis

4.1 Regression Introduction

In this chapter there an analysis of the empirical findings will be presented with the aim to answer the study's research questions which are the following:

- *How is a country's level of development correlated with the level of economic damage they suffer from a natural disaster?*
- *How does the level of development affect the number of deaths caused by a natural disaster?*

To examine the relationships between the dependent variables respectively and the independent variables used for defining the level of development in a country, a regression equation of the following form is built up:

$$y = \beta_0 + \beta_1 x_1 + \cdots + \beta_i x_i + e$$

$y = dependent\ variable\ we\ seek\ to\ explain$

$\beta_0 = constant$

$\beta_{1\ldots i} = explanatory\ independent\ variables$

$e = error\ term, includes\ omitted\ variables$

The dependent variables for the regressions are Total Economic Loss and Total Loss of Lives.

Total Economic Loss represents the total economic value of the losses caused by direct and indirect damages from a natural disaster.

Total Loss of Lives is equal to how many people lost their lives due to a natural disaster.

The independent variables we find relevant to decide the level of development are gross capital formation, adult literacy rate, control of corruption, rule of law, life expectancy and voice and accountability.

Gross Capital Formation is represented by the value of the capital stock which consists of investments in land, plants, machinery, equipment, construction of roads, railways, schools, offices, hospitals, private residential dwellings and commercial and industrial buildings (World Bank Data, 2013).

Adult Literacy Rate is the percentages of the population aged 15 and above who can, with understanding, read and write a short, simple statement on their everyday life. Generally, 'literacy' also includes 'numeracy', the ability to make simple arithmetic calculations. This indicator is calculated by dividing the number of literates aged 15 years and over by the

corresponding age group population and multiplying the result by 100 (World Bank Data, 2013).

Life Expectancy indicates the number of years a newborn infant would live if current patterns of mortality at the time of its birth were to stay the same throughout its life (World Bank Data, 2013).

Voice and Accountability is the extent in which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media (World Bank Info, 2013).

Rule of Law captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence (World Bank Info, 2013).

Control of Corruption refers to in what extent public power is held for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests (World Bank Info).

A correlation between at least one of the independent variables and the dependent variable is hoped to be found by analyzing the t- and p-values in each of the four regressions.

The disasters chosen to be included in the regressions can be found in appendix 1.

4.2 Regressions for Economic Losses

$$Economic\ loss = \beta_0 + \beta_1 grosscapitalformation + \beta_2 adultliteracy + \beta_3 lifeexpect + \beta_4 voiceaccountability + \beta_5 ruleoflaw + \beta_6 controlofcorrupt + e$$

Developing Countries

```
. reg economicloss grosscapitalformation adultliteracyrate lifeexpectancy voicea
> ndaccountability ruleoflaw controlofcorruption
```

Source	SS	df	MS		
Model	7.3226e+20	6	1.2204e+20	Number of obs	= 16
Residual	1.9252e+21	9	2.1391e+20	F(6, 9)	= 0.57
				Prob > F	= 0.7454
				R-squared	= 0.2755
				Adj R-squared	= -0.2074
Total	2.6575e+21	15	1.7716e+20	Root MSE	= 1.5e+10

economicloss	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
grosscapit~n	-.0269155	.0694902	-0.39	0.708	-.1841133	.1302822
adultliter~e	9.39e+07	2.14e+08	0.44	0.671	-3.89e+08	5.77e+08
lifeexpect~y	7.94e+08	1.27e+09	0.62	0.549	-2.09e+09	3.68e+09
voiceandac~y	-1.47e+07	3.15e+08	-0.05	0.964	-7.28e+08	6.98e+08
ruleoflaw	3.82e+08	5.75e+08	0.66	0.523	-9.19e+08	1.68e+09
controlofc~n	-2.14e+08	6.03e+08	-0.35	0.731	-1.58e+09	1.15e+09
_cons	-5.46e+10	7.97e+10	-0.69	0.510	-2.35e+11	1.26e+11

Developed Countries

```
. reg  economicloss grosscapitalformation adultliteracyrate lifeexpectancy
  voiceandaccountability ruleoflaw controlofcorruption
```

Source	SS	df	MS		
Model	1.5165e+22	6	2.5275e+21	Number of obs	= 15
Residual	2.4774e+22	8	3.0968e+21	F(6, 8)	= 0.82
				Prob > F	= 0.5864
				R-squared	= 0.3797
				Adj R-squared	= -0.0855
Total	3.9939e+22	14	2.8528e+21	Root MSE	= 5.6e+10

economicloss	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
grosscapit~n	.0078903	.0162288	0.49	0.640	-.0295335	.0453141
adultliter~e	-6.76e+09	1.20e+10	-0.56	0.588	-3.44e+10	2.08e+10
lifeexpect~y	7.65e+09	6.03e+09	1.27	0.240	-6.25e+09	2.15e+10
voiceandac~y	-2.13e+09	1.20e+09	-1.77	0.114	-4.89e+09	6.42e+08
ruleoflaw	2.55e+08	4.25e+09	0.06	0.954	-9.54e+09	1.00e+10
controlofc~n	2.04e+09	4.51e+09	0.45	0.663	-8.36e+09	1.24e+10
_cons	8.87e+10	9.79e+11	0.09	0.930	-2.17e+12	2.35e+12

4.3 Regressions for Loss of Lives

$$Loss\ of\ lives = \beta_0 + \beta_1 grosscapitalformation + \beta_2 adultliteracy + \beta_3 lifeexpect + \beta_4 voiceaccountability + \beta_5 ruleoflaw + \beta_6 controlofcorrupt + e$$

Developing Countries

```
. reg numberofdeaths grosscapitalformation adultliteracyrate lifeexpectancy
  voiceandaccountability ruleoflaw controlofcorruption
```

Source	SS	df	MS		
Model	4.5093e+10	6	7.5155e+09	Number of obs =	16
Residual	6.3799e+10	9	7.0888e+09	F(6, 9) =	1.06
				Prob > F =	0.4497
Total	1.0889e+11	15	7.2595e+09	R-squared =	0.4141
				Adj R-squared =	0.0235
				Root MSE =	84195

numberofde~s	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
grosscapit~n	1.29e-07	4.00e-07	0.32	0.755	-7.76e-07	1.03e-06
adultliter~e	-919.6444	1229.665	-0.75	0.474	-3701.339	1862.051
lifeexpect~y	8781.879	7336.094	1.20	0.262	-7813.519	25377.28
voiceandac~y	-310.8378	1814.02	-0.17	0.868	-4414.437	3792.761
ruleoflaw	-578.1127	3310.613	-0.17	0.865	-8067.24	6911.015
controlofc~n	-2283.393	3469.529	-0.66	0.527	-10132.01	5565.226
_cons	-397512.5	458792.3	-0.87	0.409	-1435373	640347.8

Developed Countries

```
. reg  numberofdeaths grosscapitalformation adultliteracyrate lifeexpectancy
  voiceandaccountability ruleoflaw controlofcorruption
```

Source	SS	df	MS		
Model	6.9234e+09	6	1.1539e+09	Number of obs =	15
Residual	110704400	8	13838049.9	F(6, 8) =	83.39
				Prob > F =	0.0000
Total	7.0341e+09	14	502438547	R-squared =	0.9843
				Adj R-squared =	0.9725
				Root MSE =	3720

numberofde~s	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
grosscapit~n	-1.57e-09	1.08e-09	-1.45	0.185	-4.08e-09	9.28e-10
adultliter~e	-2372.787	800.1161	-2.97	0.018	-4217.857	-527.7156
lifeexpect~y	678.1348	402.8946	1.68	0.131	-250.9419	1607.212
voiceandac~y	-1357.934	80.23174	-16.93	0.000	-1542.949	-1172.92
ruleoflaw	-171.5251	283.806	-0.60	0.562	-825.9829	482.9327
controlofc~n	752.9112	301.4625	2.50	0.037	57.73741	1448.085
_cons	250702.8	65457.38	3.83	0.005	99757.85	401647.8

5 Results

Economic losses – developing countries

By looking at the t- and p-values in the table above, there is evidence supporting that none of the variables are significant in explaining the economic loss a developing country suffer from a natural disaster. The r-squared of 0.2755 is saying that only 27.55% of economic losses can be explained by the variables chosen for the regressions.

Economic losses – developed countries

In the case of developed countries, the t- and p-values for the variables *life expectancy* and *voice and accountability* are more significant than in the regression for developing countries. There is not a big difference but it is noticeable. The r-squared is also higher revealing that the chosen variables explain more of the economic losses in developed countries than in developing countries.

Loss of lives – developing countries

The results from this regression are similar to the one for economic losses. What is interesting here is that the variable *life expectancy* has a somewhat higher t-value compared to the other variables, meaning it is more significant in explaining the number of lives lost due to a natural disaster. However, a p-value of 0.262 is not significant seeing it should be below 0.05 in order for it to be an important explanatory variable.

The r-squared of 0.4141 is also higher than in the previous regression saying that the variables may be more adequate in explaining lives lost than the economic loss.

Loss of lives – developed countries

From this regression it can be found that several variables are significant in explaining the dependent variable *number of deaths* by lookng at the t- and p-values. The variable *voice and accountability* seem to be especially significant with a t-statistic of 16.93 and a p-value of 0.000. However, considering the case, it is likely to believe that the variable is overestimated because of an omitted variable bias. It seems odd that the relevance of *voice and accountability* would be so much more significant in explaining the number of deaths in developed countries than in the developing countries. The high r-squared of 98.43% is probably caused by the omitted variable bias, but it would still be rather high also without that variable since there are other significant variables.

6 Discussion

To summarize the results from the regressions, support has not been able to retrieve for the theory that the state of development in a country affects economic losses or loss of lives caused by a natural disaster. The results may be caused by a lack of some relevant variables that are important in explaining the state of development within a country. However, reality shows that more developed countries lose more money and are able to save more lives and the opposite goes for developing countries.

In the regressions for economic losses due to a natural disaster, the dependent variable is not significantly explained by the independent variables chosen for the analysis to define state of development. From the examples in the empirical section, there is evidence for the developed countries to lose more money after a natural disaster than the developing countries. Japan, one of the most well developed countries in the world, lost about $177 billion while Haiti, one of the least developed, lost only $7.9 billion.

The high rate of corruption and the low rule of law in Haiti, for example, is an obvious reason for the low development within the country which can limit disaster preparedness. It does not create a good environment for foreign direct investments or doing business in Haiti in general, nor does it encourage education which limits developing technology and improving infrastructure. This limits the possible economic losses due to a natural disaster compared to Japan who has a very well developed infrastructure and advanced technology.

The low r-squared in the regressions, for both countries, could indicate a lack of appropriate variables that could better explain economic losses. Instead of measuring physical capital by the value of investments made one specific year, it could be more suitable in the regression to have a current total economic value of all land, plants, machinery, equipment, construction of roads, railways, schools, offices, hospitals, private residential dwellings and commercial and industrial buildings a country has. It is obvious that developed countries have more advanced infrastructure etc. and if these get destroyed it is only natural that the expenses and losses will be bigger for them than for developing countries.

The results from the two regressions on lives lost due to a natural disaster are very different. The variables that were chosen seem more suitable in the case of developed countries where *Adult Literacy rate, Voice and Accountability and Control of Corruption* are all significant. With a higher literacy rate, it is likely to believe that people are more educated and therefore more aware of how to minimize the direct effects from a natural disaster. It might contribute to prevent many people of dying since people will be able to search information, find out how to protect themselves and how to handle a critical event such as a natural disaster.

It cannot, with certainity, be said which of the two regressions is more accurate. The variable *Rule of Law* was believed to be of greater importance because established property rights should increase the likelihood of evacuating before a natural disaster. People will want to feel secure when leaving their homes, knowing that e.g. occupations won't occure and they can return without complications. A reason to why this variable is not significant in the regressions, might be because the presence of a working warning system is a better

explanation to if people evacuate or not. In Louisiana and the other states affected, people were warned before and were able to leave in time. While during the Indian Ocean Tsunami, people were taken by surprise because they didn't have a disaster warning system. With the high level of Rule of Law in the U.S., people knew they would be able to return as long as their homes had not been destroyed by the hurricane. It is difficult to know what is regarded to be most important, because even if e.g. Haiti had been warned of the coming earthquake, it is not certain that the Haitians would have evacuated. It is hard to say which is valued the highest, to stay and guard the house hoping to survive the disaster or to evacuate and hope to be able to return to their homes without it being occupated by strangers.

Even though the regressions show different results, it is still a fact that the total death toll in Japan was about 1/19 of the Haitian one and about 1/10 of the death toll caused by the Indian Ocean Tsunami. The hurricane in the U.S. was one of the worst that the country had ever experienced but since they were able to evacuate most of the people from the danger zones, they were also able to save many lives.

In a final step to link together the empirical section and the analysis section, it would have been preferred to perform one more regression for each group of countries regarding recovery and reconstruction using the same variables in defining state of development. A regression like that would have requested data for the total costs and money spent on recovery and reconstruction, which has not been able to retrieve since the natural disasters from the applications took place recently, therefore the countries are still in progress towards complete recovery.

When comparing recovery and reconstruction after the natural disasters in the four countries from our applications, there seem to be a pattern where the developed countries are able to construct a recovery plan and follow it relatively closely while e.g. Haiti is very unorganized on this matter. More than three years after the earthquake, Haiti is still in a recovery phase where they are dealing with the direct damages such as cleaning up debris in order to rebuild homes and treating damaged and sick people. Japan, on the other hand, did not suffer as critical human losses as Haiti and have therefore been able to faster move on to focusing on long-term reconstruction. Indonesia was able to reach the reconstruction phase more easily than Haiti, the difference there seem to be that Indonesia got a lot of help and support from the international community and they were able to organize this. In Haiti, there are so many actors trying to get the Haitians back on their feet that organizing the support becomes close to impossible and therefore prevents a smoother recovery and reconstruction.

The regressions did not generate the results expected. Most likely, this is because more specific variables could have been included in our model. The results might also be questionable since we do not have a large number of observations. This, however, is justified by the decision to only include disasters of a certain severeness and that they had occurred during approximately the past 30 years.

From the results it has been concluded that generalizations cannot be made on how a country is affected by a natural disaster. It is possible that the disasters should not be categorized by if

they took place in developing or developed countries and that it is not reliable to expect effects on economy and humans to be affected similarly over the world. Every natural disaster is different. Even though the natural disasters chosen for this analysis are considered significant according to the guidelines of the International Disaster Database, they are still very different. Some are floods, some are earthquakes, some are storms etc. The results could have been different and more substantial if the groups would have been organized by type of disaster instead of by type of country.

6 Conclusions and suggestions for further research

The aim of this study was to find an explanation to why developing countries lose more people and less money because of a natural disaster compared to developed countries. We decided to define a stage of development by the variables Gross Capital Formation, Adult Literacy Rate, Life Expectancy, Voice and Accountability, Rule of Law and Control of Corruption. We hoped that these variables would be sufficient and significant in explaining the level of economic loss and the number of lives lost due to a natural disaster. This, however, was not the case, but from our illustrated examples and from the disasters used in the regression we can see a clear division where developing countries lose more people compared to developed countries and developed countries lose more money than developing countries.

Suggestions for further research on this subject could be to include a dummy variable in the regression for if a country has a working warning system for natural disasters or not. A variable representing the magnitude of a natural disaster that applies on all types of disasters, gathering all different types of natural disasters under one common scale could also be useful. Instead of the previous suggestion one might also consider performing regressions separately for every type of natural disaster since then a variable measuring the magnitude would probably work very well as an explanatory variable. Another example of improving the regression could be to perform one single regression for all countries and not dividing them into developed and developing countries and instead using a dummy variable for which category it belongs to.

List of References

Reports

Aceh Road/Bridge Reconstruction and Rehabilitation Project, 2012, *Parson*
Available at: http://www.parsons.com/projects/pages/aceh-road.aspx
[Accessed on 2013-05-05]

The Action Plan, 2010, *Inside Disaster*
Availale at: http://insidedisaster.com/haiti/recovery/the-action-plan
[Accessed on 2013-05-02]

Amadeo, K., (2012, 31 Oct), "How Much Did Hurricane Katrina Damage the U.S. Economy?" *About.com*
Available at: http://useconomy.about.com/od/grossdomesticproduct/f/katrina_damage.htm

Amnesty International, (2013), "Nowhere to go: Forced Evictions in Haiti's Displacement Camps", *Amnesty International*

Amunátegui, M.F., (2012), "Haiti Moving Forward Step by Step", *United Nations in Haiti*

Army Corps of Engineers, 2010, *abc World News*
Available at: http://abcnews.go.com/WN/katrina-things-stand-orleans-louisiana-hurricane-protection/story?id=11490336#.UX4Q4ispZmo
[Accessed on 2013-04-29]

Baker McNeill, J., Carafano, J.J., Mayer M.A. and Weitz, R., (2011), "Accepting Disaster Relief from Other Nations - Lessons from Katrina and the Gulf Oil Spill", *Heritage Foundation*

Bell, K.C., (2011), "After the Tsunami: Women and Land Reforms in Aceh", *World Bank*

The Boxing Day Tsunami, 2013, *Tsunami Evaluation Coalition*
Available at: http://www.thebcom.org/ourwork/reliefwork/96-the-boxing-day-tsunami-factsand-figures.html?showall=1
[Accessed on 2013-05-05]

Brainmass, 2013, *BrainMass Incorporated*
Available at: http://brainmass.com/economics/macroeconomics/226310
[Accessed on 2013-05-17]

The Brookings Institution Metropolitan Policy Program, (2007), "The Katrina Index: Summary of Findings", *The Brookings Institution*

Buerk, R., (2012, 11 March), "Japan Marks Quake and Tsunami Anniversary", *BBC News*

Available at: http://www.bbc.co.uk/news/world-asia-17326084

Bureau of Economic Analysis, 2012, *U.S Department of Commerce*
Available at:
http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=1#reqid=70&step=10&isuri=1&7007=-1&7093=Levels&7090=70&7035=-1&7036=-1&7001=1900&7002=1&7003=900&7004=NAICS&7005=-1&7006=22000,28000
[Accessed on 2013-04-28]

Bureau of Economic Analysis, 2013, *U.S. Department of Commerce*
Available at:
http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=1#reqid=70&step=10&isuri=1&7007=2010,2009,2008,2007,2006,2005,2004,2003,2002&7093=Levels&7090=70&7035=-1&7036=-1&7001=1900&7002=1&7003=900&7004=NAICS&7005=-1&7006=28000
[Accessed on 2013-04-28]

Chantrill, C., (2013), *U.S. Government Spending*
Available at:
http://www.usgovernmentspending.com/year_spending_2012USbn_14bs1n_F0F1#usgs302
[Accessed on 2013-04-30]

Corbett, J., 2012, *East Asia Forum*
Available at: http://www.eastasiaforum.org/2012/11/28/growth-getting-japan-back-on-track/,
[Accessed on 2013-05-04]

Department of Homeland Security, (2013)
Available at:
http://www.whitehouse.gov/sites/default/files/omb/budget/fy2014/assets/homeland.pdf

Diaz, A., Trapp, A. and Feldman, A., (2008) "Haiti Background Report", *Lehigh University*

Disaster Management, 2013, *Queensland Government*
Available at:
http://www.disaster.qld.gov.au/About_Disaster_Management/Management_Phases.html
[Accessed on 2013-05-04]

Division of Administration, 2008, *Government of Louisiana*
Available at: http://doa.louisiana.gov/about_industry.htm
[Accessed on 2013-04-29]

Do Something, *Do Something.org*
Available at:
http://www.dosomething.org/actnow/tipsandtools/11-facts-about-hurricane-katrina
[Accessed on 2013-04-27]

Economagic, 2013, *Economagic – Economic Time Series Page*
Available at: http://www.economagic.com/em-cgi/data.exe/blsla/lasst22000006
[Accessed on 2013-04-27]

Economics and Statistics Administration (ESA), 2006, "The Gulf Coast: Economic Impact and Recovery One Year after the Hurricanes" *U.S. Department of Commerce*

Econterms, 2013, *About.com*
Available at: http://economics.about.com/od/economicsglossary/g/tfp.htm
[Accessed on 2013-04-27]

Floodsite Project, 2009, *FLOODsite Consortium*
Available at:
http://www.floodsite.net/juniorfloodsite/html/en/student/thingstoknow/geography/katrina2.html
[Accessed on 2013-04-28]

Fraser, S., Matsuo, I., Leonard, G.S. and Murakami, H., (2012), "Tsunami Evacuation: Lessons from the Great East Japan earthquake and tsunami of March 11th 2011", *Institute of Geological and Nuclear Sciences Limited*

Global Finance, 2012, *Global Finance Magazine*
Available at: http://www.gfmag.com/gdp-data-country-reports/260-haiti-gdp-country-report.html#axzz2PyFO693h
[Accessed on 2013-04-09]

Government of Japan, (2011), "Economic Impact of the Great East Japan Earthquake and Current Status of Recovery", *Government of Japan*

Hallegatte, S. and Przyluski, V., (2010), "The Economics of Natural Disasters - Concepts and Methods", *World Bank*

Henderson, J.V., Lee, Y.S., (2011), "Organization of Disaster Aid Delivery: Spending Your Donations", *Brown University*

Herman, C., (2006, 25 Aug), "Katrina's Economic Impact: One Year Later", *ABC News*
Available at:
http://abcnews.go.com/Business/HurricaneKatrina/story?id=2348619&page=2#.UXvB_7WeOSo

History, (2013), *The History Channel website*
Available at: http://www.history.com/topics/hurricane-katrina
[Accessed on 2013-04-27]

ICG (International Crisis Group), (2001a) "Aceh: Why Military Force Won't Bring Lasting Peace", *Jakarta and Brussels: ICG*

Index Mundi, 2013, *Index Mundi*
Available at: http://www.indexmundi.com/japan/gdp_real_growth_rate.html
[Accessed on 2013-04-08]

Index Mundi, 2013, *Index Mundi*
Available at: http://www.indexmundi.com/facts/myanmar/gross-capital-formation#NE.GDI.TOTL.ZS
[Accessed on 2013-05-08]

The International Disaster Database, 2009, *The International Disaster Database*
Available at: http://www.emdat.be
[Accessed on 2013-04-07]

James, E., (2006), "Clean or corrupt: Tsunami aid in Aceh", *The Australian National University*

Japan Reconstruction Agency, (2013), "Current Status and Path Toward Reconstruction", *Japan Reconstruction Agency*

Japan Inc, 2010, *Japan Inc*
Available at: http://www.japaninc.net/history-of-the-modern-japanese-economy/
[Accessed on 2013-04-05]

Johannesson, M., 2011, *Landguiden – Utrikespolitiska Institutet*
Available at: http://www.landguiden.se/Lander/Asien/Japan/Aldre-Historia
[Accessed on 2013-04-04]

Johannesson, M., 2011, *Landguiden – Utrikespolitiska Institutet*
Available at: http://www.landguiden.se/Lander/Asien/Japan/Ekonomi
[Accessed on 2013-04-05]

Kellenberg, D. and Mobarak, A.M., (2011), "The Economics of Natural Disasters", *Annual Reviews*

Knoema, 2012, *Knoema*
Available at: http://knoema.com/atlas/Myanmar/GDP
[Accessed on 2013-05-07]

Louisiana Recovery Authority, (2006), "Action Plan Amendment Number 2 for Disaster Recovery Funds", *Government of Louisiana*

Lundahl, M., (2012), "The political economy of disaster", *Routledge Explorations in Economic History*

Maps of World, 2012, *Mapsofworld.com*
Available at: http://www.mapsofworld.com/japan/earthquake-2011.html
[Accessed on 2013-04-05]

McRae, M., (2011, April), "Tsunami Forces Debate over Vertical Evacuation", *American Society of Mechanical Engineers*
Available at: http://www.asme.org/kb/news---articles/articles/manufacturing---processing/tsunami-forces-debate-over-vertical-evacuation

Ministry of Foreign Affairs of Japan, 2011, *Ministry of Foreign Affairs of Japan*
Available at: http://www.mofa.go.jp/j_info/visit/incidents/reconstruction_process1110.html
[Accessed on 2013-04-05]

Ministry of Foreign Affairs of Japan, 2011, *Ministry of Foreign Affairs of Japan*
Available at: http://www.mofa.go.jp/j_info/visit/incidents/open_reconstruction1106.html
[Accessed on 2013-04-07]

Ministry of Foreign Affairs of Japan, 2011, *Ministry of Foreign Affairs of Japan*
Available at: http://www.mofa.go.jp/j_info/visit/incidents/two_years.html
[Accessed on 2013-04-07]

Murphy, K., (2010, 30 Aug) "Recalling Days of Despair in the Superdome", *Los Angeles Times*
Available at: http://articles.latimes.com/2010/aug/30/nation/la-na-0830-katrina-superdome-20100830

Nationalencyklopedin, 2013, *Nationalencyklopedin*
Available at: http://www.ne.se/lang/naturkatastrof
[Accessed on 2013-04-11]

Nanto, D.K., Cooper, W.H., Donnelly, J.M. and Johnson, R. (2011), "Japan's 2011 earthquake and tsunami: economic effects and implications for the United States", *Congressional Research Service*

Nishino,T., Ouchi, M., Tsuburaya, S., Tanaka, T. and Hokugo, A., (2012), "Emergency Evacuation of Fukushima Residents Living in the Vicinity of Nuclear Power Station", *Tokyo*

Oh, E.H., Deshmukh, A. and Hastak, M., (2010), "Disaster Impact Analysis Based on Inter-Relationship of Critical Infrastructure and Associated Industries", *Purdue University*

Park, J., Moore, J.E., Gordon, P. and Richardson, H.W., (2010), "Short-run Economic Impacts of Hurricane Katrina (and Rita)", *CESifo Forum*

Riebeek, H., (2005, 28 March) "The Rising Cost of Natural Hazards"
Available at: http://earthobservatory.nasa.gov/Features/RisingCost/rising_cost.php

Stone, C., (2012, 2 Nov), "The Economic Impact of Hurricane Sandy", *U.S. News*
Available at: http://www.usnews.com/opinion/blogs/economic-intelligence/2012/11/02/the-economic-impact-of-hurricane-sandy

Szczepanski, K., 2013, *About.com*
Available at: http://asianhistory.about.com/od/asianenvironmentalhistory/p/The-2004-Tsunami-In-The-Indian-Ocean.htm
[Accessed on 2013-04-09]

United Nations Development Programme, 2013, *United Nations*
Available at:
http://www.undp.org/content/undp/en/home/ourwork/crisispreventionandrecovery/projects_initiatives/crisis_in_haiti/
[Accessed on 2013-05-03]

United Nations News Centre, 2013b, *United Nations*
Available at:
http://www.un.org/apps/news/story.asp?NewsID=44564&Cr=disaster+risk&Cr1=#.UZXpimxvm71
[Accessed on 2013-05-17]

United Nations News Centre, 2013a, *United Nations*
Available at: http://www.un.org/apps/news/story.asp?NewsID=44799#.UZXqfGxvm72
[Accessed on 2013-05-17]

U.S. Census Bureau, 2013, *Google*
Available at: https://www.google.se/publicdata/explore?ds=kf7tgg1uo9ude_&met_y=population&idim=state:22000&dl=en&hl=en&q=louisiana%20population,
[Accessed on 2013-04-28]

Witherell, B., (2012, 9 March), "One Year after the Tsunami, Japan Is Back", *Cumberland Advisors*
Available at: http://www.cumber.com/commentary.aspx?file=030912.asp

World Bank, (2009a), "Aceh Growth Diognostic", *Jakarta*

World Bank, 2013, *World Bank Data*
Available at: http://data.worldbank.org/indicator
Accessed on: 2013-05-10

World Bank, 2013, *World Bank Info*
Available at: http://info.worldbank.org/governance/wgi/sc_country.asp
[Accessed on 2013-05-07]

Appendix 1

Table 1 – Developed Countries

Industrial countries	Economic loss $	Number of deaths	Gross capital formation $	Adult literacy rate %	Life expectancy	Voice and Accountability %	Rule of law %	Control of corruption %
USA Hurricane Katrina 2005	125000000000	1833	32600000000	99	77	89.9	91.4	91.7
Japan Earthquake 2011	177700000000	15698	1165603307856	99	83	77.9	86.9	90
USA Storm Sandy 2012	50000000000	54	2235900000000	99	79	85.9	91.1	85.3
Italy Earthquake 2012	15800000000	7	431554423263	99	82	74.6	63.4	57.3
China Earthquake 2008	85000000000	87476	1989604006853	94	73	5.3	44.2	35.4
Italy Earthquake 1980	20000000000	4689	122918164463	91	74	85.1	82.3	66.8
Italy Earthquake 2011	2500000000	295	499267202362	99	81	81.7	60.1	66.8
New Zealand Earthquake 2011	15000000000	181	31011023622	99	81	96.7	98.6	99.5
France Storm 1999	8000000000	88	273935009589	99	79	85.6	91.4	91.2
U.K. Storm 1991	900000000	48	204367897727	99	76.4	88.5	94.7	96.1
Germany Flood 2002	11600000000	27	362638810465	99	78.2	94.7	93.8	93.7
USA Hurricane Ike 2008	30000000000	82	2493600000000	99	78	85.6	91.8	91.7
Japan Earthquake 1995	100000000000	5297	1498722086847	99	79.5	80.8	90.4	84.4
Poland Flood 1997	3500000000	55	36820165341	99	73	80.3	74.6	76.7
China Flood 2010	18000000000	1691	2859619007443	94	73	75.8	63	57.4

Table 2 – Developing Countries

Developing countries	Economic loss $	Number of deaths	Gross capital formation $	Adult literacy rate %	Life expectancy	Voice and Accountability %	Rule of law %	Control of corruption %
Algeria Earthquake 2003	5000000000	2266	67059488582	73	71	17.3	34.4	30.2
Honduras Storm 1998	3793600000	14600	1608862629	80	70	47.1	18.7	22
Chile Earthquake 2010	3000000000	562	50939030385	99	79	82	87.7	90.9
Haiti Earthquake 2010	7900000000	300000	1687396664	48	73	28.9	1.9	6.7
Pakistan Earthquake 2005	9500000000	73338	20913055853	50	64	16.8	21.5	13.7
Myanmar Cyclone 2008	4000000000	138366	8305782000	89.9	64	0.5	4.8	1.9
India Flood 2006	3390000000	350	340464231649	63	64	59.1	56.9	46.3
Indonesia Tsunami 2004	9900000000	168000	61785619642	90	67	40.4	25.4	17.1
Thailand Flood 2011	4000000000	813	92040424115	92.6	74	33.3	48.8	43.6
Turkey Earthquake1999	2000000000	17127	47761766953	91	69	23.6	47.8	40
Venezuela Flood 1999	3160000000	30000	25979584525	93	73	47.6	23	25
Morocco Earthquake 2004	400000000	628	16588746053	52	70	32.2	53.6	55.1
Ukraine Flood 2008	1000000000	38	50289147934	100	68	50	25.5	22.8
Argentina Flood 2003	1028210000	23	34080800000	97.2	74	57.7	23.9	39.5
Bangladesh Flood 1998	4300000000	1050	9538112161	46	64	45.2	18.7	39
Bangladesh Storm 2007	2300000000	4234	16737271937	55	68	31.3	22	11.2